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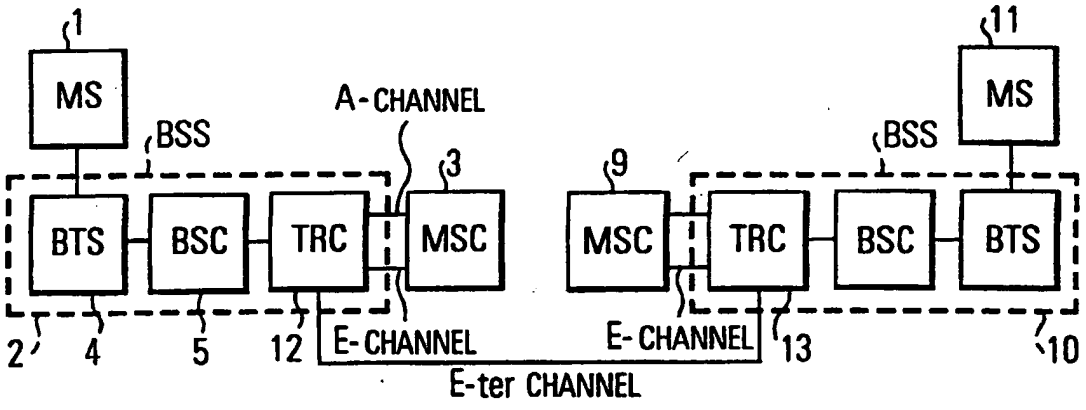
(54) Title: TRANSCODER RATE CONTROLLER



(57) Abstract: A transcoder rate controller is provided which carries out tandem free operation (TFO) transcoding on inter-switching controller signals in a data transmission network.

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TRANSCODER RATE CONTROLLER

TECHNICAL FIELD OF THE INVENTION

The present invention relates to a new transcoder rate controller for a data transmission network, in particular the GSM network, and to a new method of transmitting data between switching controllers in a data transmission network.

DESCRIPTION OF RELATED ART

Data transmission networks generally require transcoders to transcode data from one format/data rate to another format/data rate. One such data transmission network is the GSM network.

Figure 1 of the accompanying drawings is an exemplary illustration of a standard GSM network arrangement.

As can be seen, in a GSM network arrangement a mobile station (MS) 1 is connected to a base station sub-system (BSS) 2 which provides and manages transmission paths between the mobile station (MS) and the GSM network switching sub-systems. In this case, the base station sub-system (BSS) 2 is connected to a mobile switching controller (MSC) 3. The mobile switching controller (MSC) 3 controls the routing of the signal between the mobile station (MS) 1 and another mobile switching controller (MSC) via the inter-MSC E-channel, to the Public Switched Telephone Network (PSTN) or to another base station sub-system (BSS) connected to that mobile switching controller 3 (not shown). Typically, a mobile switching controller (MSC) 3 is connected to a number of base station sub-systems (BSS) 2 providing coverage for a large number of mobile stations (MS) 1.

The base station sub-system (BSS) 2 provides several different functions, which are shown in Figure 1 as separate blocks within the base station sub-system (BSS). Firstly, a base transceiver station (BTS) 4 is

provided which handles the radio communication with the mobile station (MS) 1. A base station controller (BSC) 5 controls the operation of the base transceiver station (BTS) 4. Finally, a transcoder rate controller (TRC) 6 performs GSM specific speech encoding and decoding and rate adaption for data.

The base transceiver station (BTS) 4 is connected to the base station controller (BSC) 5 by way of the A-bis channel and the base station controller (BSC) 5 is connected to the transcoder rate controller (TRC) 6 by way of the A-ter channel. The A-bis and the A-ter channel data rates are variable, and depend on the coding rate of the data received from the mobile station (MS) 1. As is well known, a number of different data rates for the speech signal received from the mobile station (MS) 1 have been specified in the GSM standard. However, the data rate is typically 4x16k for full rate/extended full rate coded speech or is 8x8k for half rate coded speech.

The use of Tandem-Free Operation for GSM speech has recently been standardised and is outlined in ETSI specification GSM 08.62. The use of Tandem-Free Operation (TFO) allows communication via in-band signalling between transcoders.

It is desirable to reduce the data rate of signals sent between adjacent mobile switching controllers (MSC) 3 on the E-channel to minimise costs. Previously, digital circuit multiplication equipment (DCME) has been provided to compress data on the E-interface. Figure 2 shows a diagrammatic representation of a previous arrangement in which a digital circuit multiplication equipment (DCME) 7 is connected to the mobile switching controller (MSC) 3 to compress the E-channel data. The digital circuit multiplication equipment (DCME) 7 provides speech compression and allows a number of speech channels to

be combined into one time slot. At the other end of the compressed E-channel interface a further digital circuit multiplication equipment (DCME) 8 decompresses the received compressed E-channel data and provides the decompressed E-channel data to its associated mobile switching controller (MSC). The mobile switching controller (MSC) 9 can forward the data on to the base station sub-system 10 corresponding to the mobile station 11 for which the data is intended.

SUMMARY OF THE INVENTION

The transmission saving provided by the use of digital circuit multiplication equipment (DCME) 7, 8 in previous arrangements is achieved at the expense of speech quality, thus resulting in an undesirable tradeoff between speech quality and transmission efficiency within the transmission network. Furthermore, the provision of a separate digital circuit multiplication equipment (DCME) 7, 8 within the E-channel between adjacent mobile switching controllers (MSC) 3, 9 undesirably increases the operation and maintenance requirement of the network. The increase in operational costs as a result of the maintenance requirement of the separate digital circuit multiplication equipment (DCME) can outweigh the benefit gained by using the digital circuit multiplication equipment (DCME).

The present invention therefore seeks to optimise both speech quality and transmission efficiency within a data transmission network whilst reducing the operation and maintenance overheads.

In accordance with the invention, therefore, the E channel data output from the mobile switching controller is routed through the transcoder rate controller. The use of the transcoder rate controller in accordance with the invention results in improved speech quality together with band width compression,

without a significant additional operation and maintenance requirement.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show how it may be bought into effect, reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 shows a standard GSM network arrangement;

Figure 2 shows a prior art arrangement utilising digital circuit multiplication equipment;

Figure 3 shows a data transmission network arrangement in accordance with the present invention;

Figure 4 shows a schematic diagram of interconnections within a first embodiment of the transcoder controller node of the present invention;and

Figure 5 shows a schematic diagram of interconnections within a combined base station controller/transcoder rate controller in accordance with a second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

An embodiment of the invention will now be described with reference to Figures 3-5.

A transcoder rate controller 12, in accordance with the invention, replaces the previously known transcoder rate controller 6 shown in Figure 1. Otherwise, the general outline of Figure 3 is similar to the arrangement shown in Figure 1, and so corresponding description will be omitted.

The transcoder rate controller (TRC) 12 of one embodiment of the present invention is shown in Figure 3 in the base station sub-system (BSS) 2 and is coupled to the mobile switching controller (MSC) 3 by way of the A-channel in the same way as the transcoder rate controller 6 shown in Figure 1. However, in contrast to the arrangement shown in Figure 1, the E- channel data output from the mobile switching controller (MSC)

3 is input to the transcoder rate controller (TRC) 12 at an E-channel interface. Transcoded data is output from the transcoder rate controller (TRC) 12 on a new channel, the E-ter channel, which is connected to the E-ter channel interface of a corresponding transcoder rate controller (TRC) 13 associated with a second mobile switching controller (MSC) 9.

The internal arrangements of a first embodiment of the new transcoder rate controller (TRC) 12 and 13 of Figure 3 are shown in Figure 4.

As outlined above, the transcoder rate controller shown in Figure 4 has an E-channel interface in addition to the A-channel interface of the known transcoder rate controller 6.

The transcoder rate controller 12 has an A-ter channel interface 120, comprising a plurality of input/output ports 121, connected to an A-channel interface 122, comprising a single input/output port 123, through an A-channel transcoder 124.

The transcoder rate controller 12 also comprises an E-channel interface 125, comprising a plurality of input/output ports 126, connected to an E-ter channel interface 127, comprising a single input/output port 128, through an E-channel transcoder 129.

The A-channel, A-ter channel, E-channel and the E-ter channel are all shown as bi-directional in Figure 4, to make clear that transcoders 124 and 129 transcode data between the respective channels, not merely in one direction. However, for simplicity, transcoding in only one direction is described below.

Figure 5 shows a second embodiment of the invention in which the transcoder rate controller in accordance with a second embodiment of the invention is co-located with the base station controller (BSC) 5 shown in Figure 1, forming a combined base station controller/transcoder rate controller (BSC/TRC) 13.

The base station controller/transcoder rate controller (BSC/TRC) 13 has an A-bis channel interface 130 instead of the A-ter channel interface 120 shown in Figure 4, but otherwise the input-output ports 131, A-channel interface 132, input/output port 133, A-channel transcoder 134, E-channel interface 135, input/output ports 136, E-ter channel interface 137, input/output port 138 and E-channel transcoder operate as described above with reference to the corresponding parts with references 121-129.

It will be clear to a skilled person that the transcoder rate controller of the present invention can be provided as a separate node, but in addition can be incorporated as a functional unit within the base station controller (BSC) of the base station system (BSS).

The operation of the transcoder rate controller in accordance with the invention will now be described.

The data received on the A-ter channel (as shown in Figure 4) and on the A-bis channel (as shown in Figure 5) is generally in the form of 4x16k for full rate/extended full rate coded speech or 8x8k for half rate coded speech, as indicated above.

Preferably, the A-channel transcoders 124, 134 transcode the data using a tandem free operation (TFO) function to output a 1x64k A-channel speech signal in which the least two significant bits (for FR or EFR speech) or the least significant bit (for HR speech) of each byte contains a TFO frame and the remaining bits contain the remainder of the PCM frame. Thus the A-channel transcoders may adhere to the GSM 08.62 TFO protocol to output TFO frames and slightly degraded PCM speech data. Alternatively, the A-channel transcoders may output non-TFO PCM speech.

In addition, the transcoder rate controller (TRC) has an E-channel interface connected to the E-channel

interface of the mobile switching controller (MSC), as indicated above. Each of the E-channel transcoders 129, 139 is connected to four input channels to receive data on the E-channel from the mobile switching controller (MSC).

If the data received on the E-channel from the mobile switching controller (MSC) does not contain any TFO frames, the E-channel transcoders 129, 139 transcode the received data without using the tandem free operation (TFO) to achieve compressed PCM speech data, as is known in the art.

If the data received on the E-channel from the mobile switching controller (MSC) contains TFO frames, the E-channel transcoder uses an enhanced TFO function, in accordance with the invention. Thus, when the E-channel transcoders 129, 139 receive TFO coded data on the input channels from the mobile switching controller, the E-channel transcoders 129, 139 extract the TFO information from the least significant bits of each byte of the 4x64k received E-channel signal and output a 1x64k channel consisting of four 16k TFO channels as the E-ter channel data. The E-ter channel data is then output through the input/output port 128, 138 to the corresponding input/output port 128, 138 of the transcoder rate controller (TRC) of another mobile switching controller (MSC).

The enhanced TFO function E-ter data can be handled in different ways at the receiving transcoder rate controller, depending on the destination of the data.

E-ter data which is to be passed to a mobile station in contact with the mobile switching controller (MSC) associated with the receiving transcoder rate controller undergoes a reverse operation to that described above, as will be apparent to a skilled person. In this case the TFO frames are extracted from

the received E-ter data and put into the LSB of data output on the E-channel to the associated mobile switching controller (MSC). The mobile switching controller (MSC) then passes the data to the relevant base station controller on the A-channel.

If the received data is to be routed to the PSTN, the TFO data received on the E-ter channel would be transcoded by the E-channel transcoders into normal PCM speech and output to the associated mobile switching controller (MSC) on the E-channel. The mobile switching controller (MSC) then passes the data to the PSTN, as is known to a skilled person.

Although the transcoder rate controllers shown in Figures 4 and 5 have only four input channels combined in the transcoder to form a single output channel, it will be clear to a skilled person that other ratios between the input and output of the transcoders 124 and 129 could be possible. In addition, in practice the transcoder rate controller may contain a plurality of each of transcoders 124, 129, 134 and 139 connected to respective corresponding input/output ports.

Thus, in accordance with the invention it is possible for the TFO protocol to be maintained for inter-mobile station (MS-MS) communications, resulting in encoding and decoding being performed only in the mobile stations.

For mobile station (MS) to public switched telephone network (PSTN) calls, the transcoders of the transcoder rate controller maintain the TFO protocol over the E-ter interface and perform the transcoding only at the transcoder rate controller connected to the public switched telephone network (i.e. transcoding at the edge).

Data calls may be routed separately by the mobile switching controller (MSC) on dedicated 64k non compressed time slots between the mobile switching

controllers (MSC).

Thus in accordance with the invention considerable savings can be made in transmission costs between mobile switching centres whilst maintaining speech quality and avoiding an increase in operation and maintenance cost.

CLAIMS

1. A transcoder rate controller having

a first transcoder means, arranged between a first channel input/output means and a second channel input/output means, for transcoding data between the first channel input/output means and the second channel input/output means, wherein the second channel input/output means is arranged to receive or transmit data on a plurality of channels at a first data rate, and the first channel input/output means is arranged to receive or transmit data on a single channel at a second data rate higher than the first data rate; and

a second transcoder means arranged between a third channel input/output means and a fourth channel input/output means, for transcoding data between the third channel input/output means and the fourth channel input/output means using a tandem free operation function (TFO), wherein the third channel input/output means is arranged to receive or transmit data on a plurality of channels at a third data rate, and the fourth channel input/output means is arranged to receive or transmit data on a single channel at the same data rate.

2. A transcoder rate controller, as claimed in claim 1, wherein the first transcoder means comprises a plurality of first transcoders, each first transcoder being arranged between corresponding respective first channel input/output port and second channel input/output ports.

3. A transcoder rate controller, as claimed in claim 1 or 2, wherein the second transcoder means comprises a plurality of second transcoders, each second transcoder being arranged between corresponding respective third channel input/output ports and a fourth channel input/output port.

4. A transcoder rate controller, as claimed in

one of claims 1-3, wherein the first transcoder means is adapted to transcode between A-channel data received or transmitted at the first channel input/output means and either A-ter or A-bis channel data received or transmitted at the second channel input/output means.

5. A transcoder rate controller, as claimed in one of claims 1-4, wherein the second transcoder means extracts TFO frames from data received on the plurality of channels at the third channel input/output means and combines said TFO frames to form the signal output at the fourth channel input/output means.

6. A transcoder rate controller as claimed in any preceding claim wherein the first transcoder means transcodes data using a tandem free operation function (TFO)

7. A base station sub-system incorporating a transcoder rate controller as claimed in any preceding claim.

8. A data transmission network arrangement in which a mobile switching controller of the data transmission network is associated with a transcoder rate controller as claimed in one of claims 1-6 or the transcoder rate controller of the base station sub-system as claimed in claim 7, in which the A- channel of the mobile switching controller is connected with the first channel input/output means of the transcoder rate controller and the E-channel of the mobile switching controller is connected to the third channel input/output means of the transcoder rate controller.

9. A method of transmitting data between a first and a second switching controller of a data transmission network comprising the steps of:

outputting data from the first switching controller on a plurality of channels at a first data rate;

combining data from said plurality of channels in

a transcoder rate controller using a tandem free operation function to produce a single channel with same data rate; and

transmitting data on said single channel to a corresponding transcoder rate controller associated with the second switching controller.

FIG.1

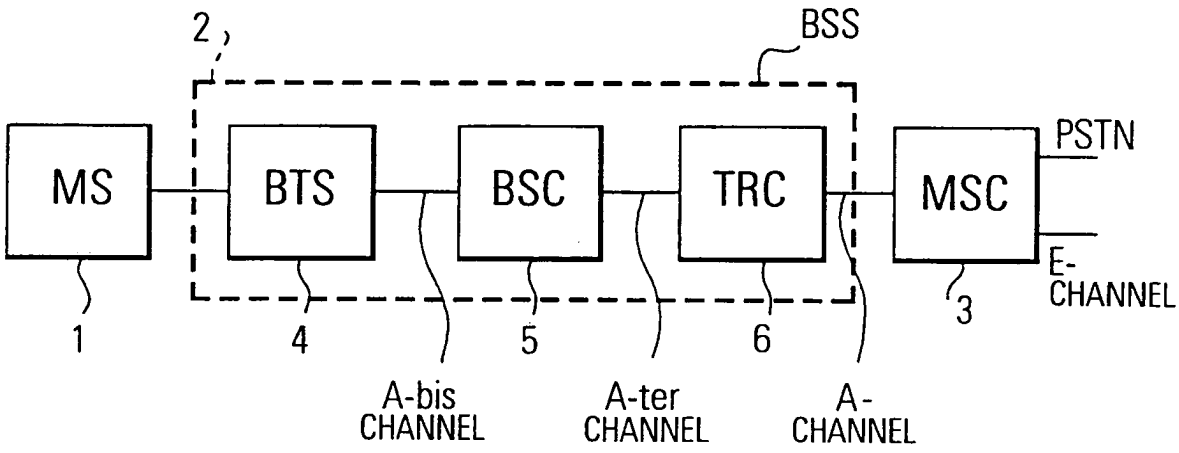

2
BSS
MS
BTS
BSC
TRC
MSC
PSTN
E-
CHANNEL
1
4
5
6
3
A-bis
CHANNEL
A-ter
CHANNEL
A-
CHANNEL

FIG.5

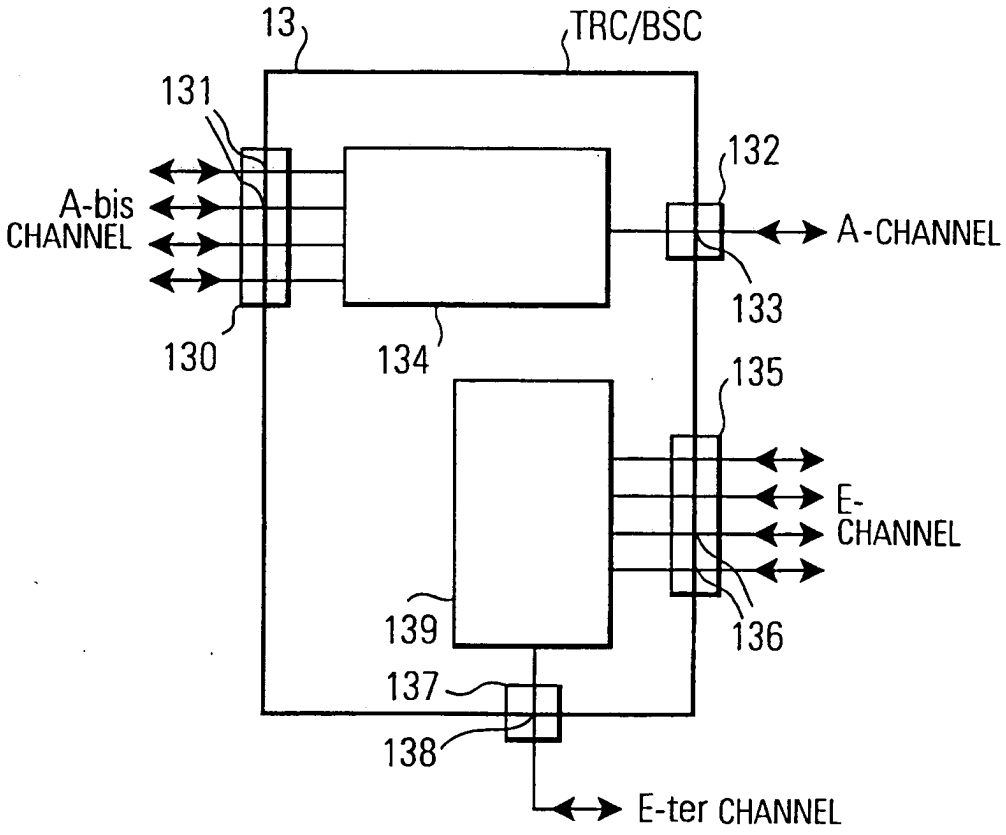

13
TRC/BSC
131
132
A-bis
CHANNEL
A-CHANNEL
133
130
134
135
E-
CHANNEL
139
136
137
138
E-ter CHANNEL

FIG.2

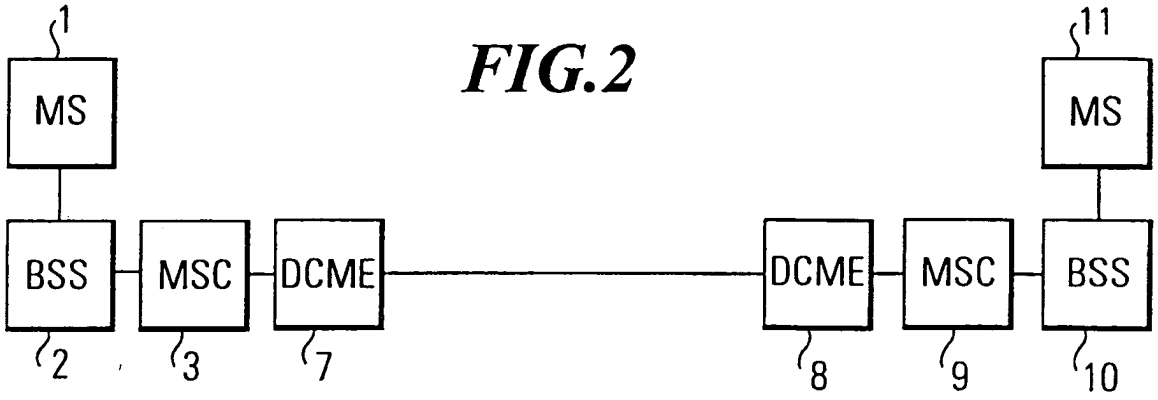


FIG.3

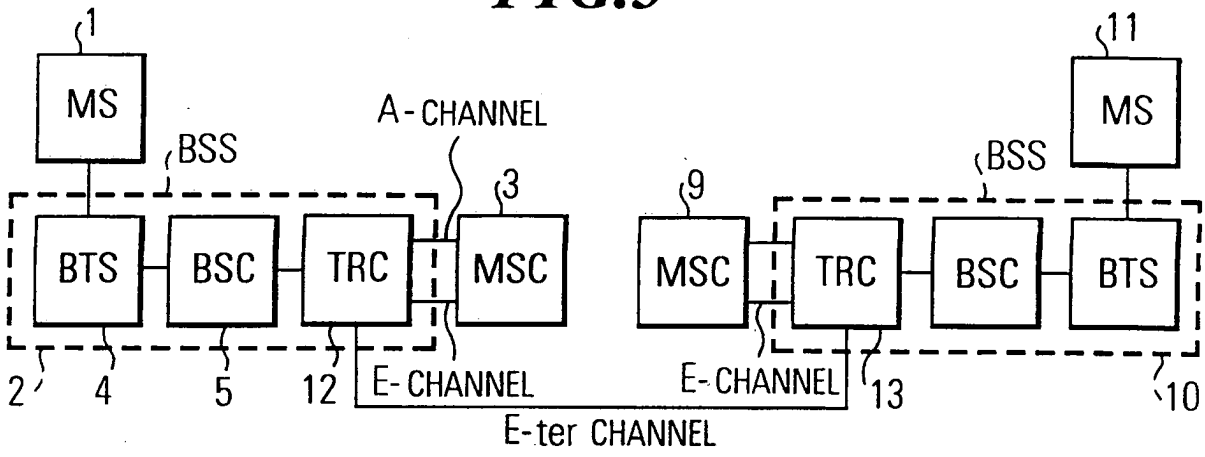
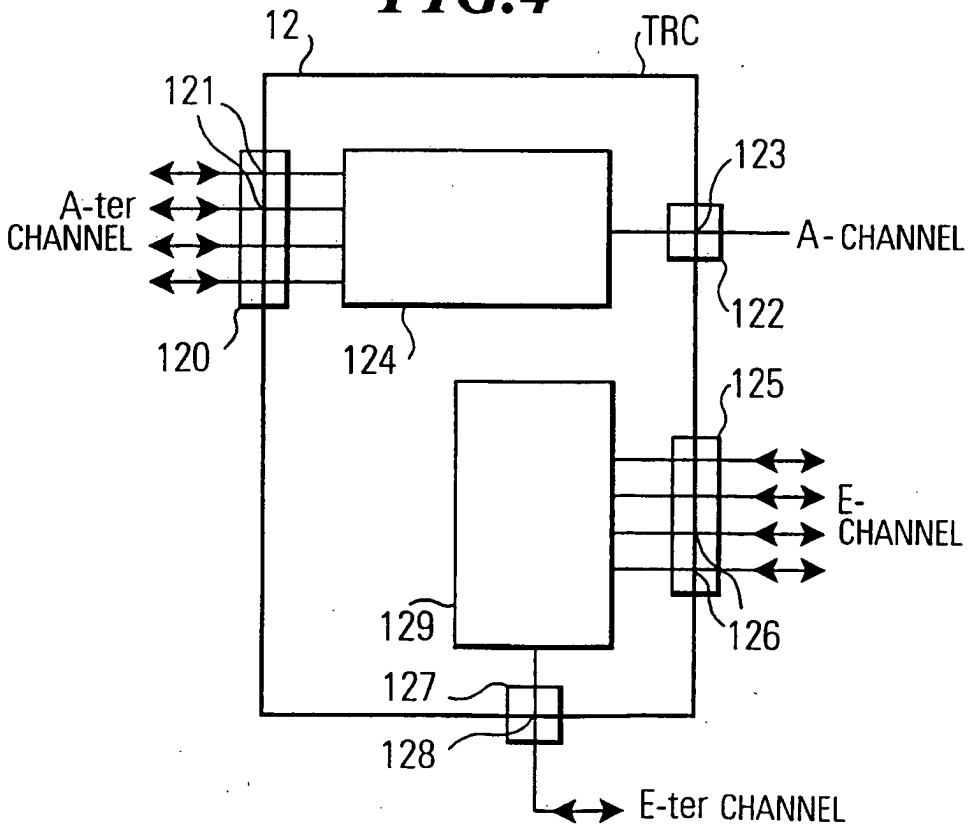


FIG.4



INTERNATIONAL SEARCH REPORT

Interr. ...nal Application No
PCT/EP 00/07394

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 97 29566 A (NOKIA TELECOMMUNICATIONS OY ;LEHTIMAEKI MATTI (FI)) 14 August 1997 (1997-08-14) page 1, line 19 - line 27 page 13, line 4 -page 16, line 5 page 20, line 1 - line 26	1-9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
6 December 2000	27/12/2000

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. .onal Application No
PCT/EP 00/07394

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